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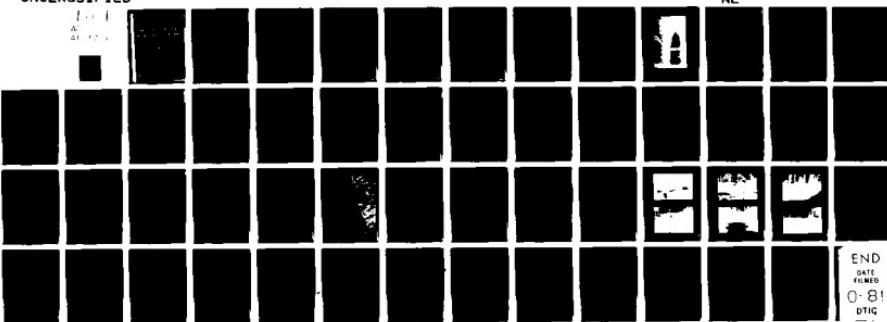
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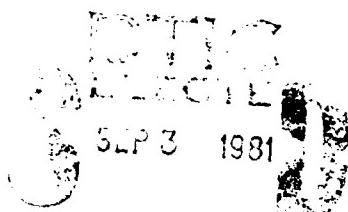
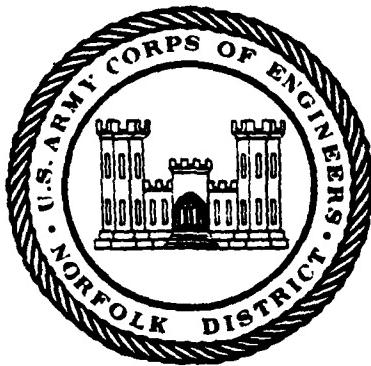
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Name of Dam: Horners Dam

Location: Westmoreland County, State of Virginia

Inventory Number: VA 19305

# PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS  
803 FRONT STREET  
NORFOLK, VIRGINIA 23510

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PREPARED BY

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April 1981

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: HORNERS DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Horners Dam  
State: Commonwealth of Virginia  
County: Westmoreland  
USGS 7.5 Minute Quadrangle: Champlain, Virginia  
Stream: Mill Swamp Creek  
Date of Inspection: 13 January 1981

BRIEF ASSESSMENT OF DAM

Horners Dam is an earthfill embankment 16.7 feet high<sup>1</sup> and approximately 600 feet long. The dam, located approximately 8.8 miles southeast of Oak Grove, Virginia is used for recreation. The dam is owned by Jack C. Gouldman, Oak Grove, Virginia 22443. Horners Dam is a "small" size - "significant" hazard structure as defined by the Recommended Guidelines for Safety Inspections of Dams. The dam and appurtenant structures were found to be in fair overall condition at the time of inspection. Past maintenance of the dam has been inadequate.

The principal spillway, located at the left abutment, is a rectangular-shaped, broad-crested reinforced concrete weir 19.4 feet wide. A 10 foot wide vegetated earth emergency spillway is cut into the right abutment<sup>2</sup>. There are no facilities for dewatering the reservoir.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the spillway design flood (SDF). The spillway is capable of passing up to 6 percent of the Probable Maximum Flood (PMF) or 32 percent of the SDF without overtopping. Based on the present unoccupied status of the house located within the downstream channel about 200 feet downstream of the spillway, a dam failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam over that which would exist just before overtopping failure. However, overtopping flows are considered detrimental to the embankment. Therefore, the spillway has been adjudged as inadequate, but not seriously inadequate.

<sup>1</sup>Measured from the streambed at the downstream toe of the dam to the average top of dam.

<sup>2</sup>Facing downstream.

NAME OF DAM: HORNERS DAM

In the event that the unoccupied house located within the downstream channel should be reoccupied, or if any other residence is established along VA Route 625 within the downstream channel of Horners Dam, a qualified professional consultant should be retained to determine spillway adequacy, remedial work, and to assess the dam's stability. Included within the stability assessment should be an investigation to determine if the apparent seep below the center of the downstream slope and the slide area on the downstream slope pose a threat to the stability of the dam. The owner is required to engage the services of the consultant within two months of the reoccupancy of the existing house or establishment of a new residence. The owner is required to have the consultant's report and to have reached agreement with the Commonwealth of Virginia regarding remedial measures within six months of the reoccupancy or establishment of new residence.

The apparent seep near the center of the dam should be examined at regular intervals and after periods of heavy rain for turbidity and/or increase in flow, which may indicate the potential for piping of embankment material.

A warning system and emergency action plan should be developed and implemented as soon as possible.

Regular inspections should be made of the dam and appurtenant structures. A thorough check list should be compiled for use by the owner or the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

The following repair items should be accomplished as part of the general maintenance of the dam:

- 1) Cut all trees on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should also have their root systems removed. The resultant holes should be backfilled, compacted and seeded.
- 2) Backfill, regrade, compact and seed all areas of erosion.
- 3) Install a staff gage to monitor reservoir levels above normal pool.
- 4) Backfill, compact and seed the low area on the left abutment to the average elevation of the embankment crest.

NAME OF DAM: HORNERS DAM

- 5) Remove the pile of brush located on the downstream side of the crest of the embankment immediately to the right of the principal spillway.
- 6) Place riprap on the upstream face of the dam to minimize erosion due to wave action.

MICHAEL BAKER, JR., INC.

SUBMITTED:

Original signed by  
**JAMES A. WALSH**

James A. Walsh, P.E.  
Chief, Design Branch

ORIGINAL SIGNED BY:  
**CHARLES C. HICKS**

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Co. **Jack G. Starr, P.E.**  
Chief, Engineering

APPROVED:

Original signed by:  
**Douglas L. Haller**  
Douglas L. Haller  
Colonel, Corps of Engineers  
District Engineer

Date:

APR 27 1981



NAME OF DAM: HORNERS DAM

**OVERALL VIEW OF DAM**



PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NAME OF DAM: HORNERS DAM ID# VA 19305

SECTION 1 - PROJECT INFORMATION

1.1 General

- 1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.
- 1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Horners Dam is an earthfill embankment 16.7 feet high<sup>1</sup> and approximately 600 feet long with a crest width of approximately 8.0 feet. The upstream and downstream embankment slopes are approximately 1.7H:1V and 2.5H:1V, respectively. There is no information available on a cut-off trench or zoning of materials for the embankment. No evidence of an internal drainage system or slope protection for the dam was found. The dam has an average crest elevation of 1005.8 feet Temporary Bench Mark (T.B.M.)<sup>2</sup>.

The emergency spillway is a grass-covered channel with brush and brambles located on

<sup>1</sup>Measured from the streambed at the downstream toe to the embankment crest.

<sup>2</sup>All elevations are referenced to a Temporary Bench Mark located on the bottom of the left training wall on the crest of the principal spillway.

NAME OF DAM: HORNERS DAM

its upper side slopes. It is cut into the right abutment.

The principal spillway is located approximately 30 feet from the left abutment. The spillway control section is a rectangular-shaped, reinforced concrete weir 19.4 feet long, 11.6 feet wide and has a crest elevation of 1000.0 feet T.B.M. Four concrete piers, located at equal intervals within the concrete weir, support an 8-inch square concrete beam that runs across the spillway. The opening from the crest of the spillway to the bottom of the beam is 6.9 feet. The spillway training walls support a 6-foot wide wooden bridge that extends over the spillway. The discharge channel, immediately downstream of the weir, is about 25 feet wide and is comprised of a very hard clay. Flow from this discharge channel winds through a wooded area and discharges into a pool located about 110 feet downstream from the concrete weir. The discharge channel has an approximate slope of 12H:1V from the spillway to the pool. About 200 feet downstream from the pool, the channel flows through box culverts beneath Virginia Route 625.

The emergency spillway is a grass lined trapezoidal channel located at the right abutment. The emergency spillway has a crest elevation of 1003.8 feet T.B.M. and has a bottom width of about 10 feet. There is a low area on the left abutment adjacent to the principal spillway that reportedly was the location of a mill. This area has a crest elevation of 1002.6 feet T.B.M. and a width of about 20 feet. This area acts as secondary spillway.

The reservoir has a 5.41 square mile drainage area that extends primarily north and east of the dam. Smoots Mill Run drains the watershed from the east and Waverly Branch and Smith Mount Branch drains the watershed from the north. Approximately 85 percent of the watershed is wooded and moderately steep.

There are no facilities for draining the reservoir.

NAME OF DAM: HORNERS DAM

- 1.2.2      Location: Horners Dam is located in Westmoreland County, Virginia on Mill Swamp Creek, approximately 8.8 miles southeast of Oak Grove, Virginia. A Location Plan is included in Appendix I of this report.
- 1.2.3      Size Classification: The height of the dam is 16.7 feet; the reservoir storage capacity at the crest of the dam (elevation 1005.8 feet T.B.M.) is 443 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.
- 1.2.4      Hazard Classification: There is one unoccupied house located within the downstream channel about 200 feet downstream of the spillway. An occupied house located about 350 feet southeast of the spillway is situated above the elevation of the dam; it would not be affected should the dam fail. VA Route 625 crosses the downstream channel about 300 feet from the spillway. In the event of dam failure, loss of life is not considered highly probable due to the present unoccupied status of the house. However, economic damage to VA Route 625 is very likely; therefore, Horners Dam is considered to be in the "significant" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only, and is not related to its stability or probability of failure.
- 1.2.5      Ownership: The dam and reservoir are owned by Jack C. Gouldman, Oak Grove, Virginia 22443.
- 1.2.6      Purpose of Dam: The dam and reservoir are used for recreational purposes.
- 1.2.7      Design and Construction History: The dam was constructed in 1850. No other information on the design and construction history was available.
- 1.2.8      Normal Operational Procedures: The reservoir is normally maintained at the crest elevation

NAME OF DAM: HORNERS DAM

of the spillway at elevation 1000.0 feet T.B.M. No formal operating procedures are followed for this structure.

### 1.3 PERTINENT DATA

- 1.3.1 Drainage Area: The drainage area tributary to the dam is naturally divided into two drainage basins which meet at the reservoir. The two basins have areas of 2.73 square miles and 2.68 square miles. The total drainage area above Horners Dam is 5.41 square miles.
- 1.3.2 Discharge at Dam Site: The maximum discharge from the reservoir is unknown. With the pool level at the top of dam, the spillways are capable of passing a discharge of 1106 c.f.s.
- 1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are provided in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation (feet T.B.M.)	Area (acres)	Reservoir Capacity		
			Acre- feet	Watershed (inches)	Length (feet)
Top of Dam <sup>1</sup>	1005.8	57.1	443	1.54	2900
Emergency Spillway Crest	1003.8	46.4	326	1.13	2800
Secondary Spillway Crest <sup>2</sup>	1002.6	40.7	268	0.93	2400
Principal Spillway Crest	1000.0	31.4	170	0.59	2200
Streambed at toe	989.1	-	-	-	-

<sup>1</sup>Average top of dam.

<sup>2</sup>Represents the eroded area on the left side of the principal spillway.

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## SECTION 2 - ENGINEERING DATA

- 2.1 Design: Design plans, specifications, and boring logs were not available for use in preparing this report. No stability analyses or hydrologic and hydraulic data were available for review.
- 2.2 Construction: Construction records, as-built plans, and inspection logs were not available for review.
- 2.3 Evaluation: No design or construction records were available for use in assessing the condition of the dam. All evaluations and assessments in this report were based upon field observations and office analyses.

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## SECTION 3 - VISUAL INSPECTION

### 3.1 Findings

- 3.1.1 General: The field inspection was conducted on 13 January 1981. At the time of inspection, the pool elevation was 1000.2 feet T.B.M., the tailwater elevation was 989.6 feet T.B.M., and the weather was partly cloudy and cold with the temperature about 20° F. The ground surface of the embankment and abutments was generally dry. The dam and appurtenant structures were found to be in fair condition at the time of inspection. Deficiencies found during the inspection will require further investigation and remedial treatment. The following are brief summaries of these deficiencies. A Field Sketch of conditions found during the inspection is presented as Plate 1. The complete visual inspection is given in Appendix III. No record of any previous inspections was found.
- 3.1.2 Dam: The embankment was found to be in fair condition, with no surface cracks. There is a slide area on the downstream embankment adjacent to the principal spillway (Photo 3). This slide area has an approximate slope of 1.2H:1V, and involves approximately 50 feet of embankment. Brush, trees, and root systems appear to have settled with the soil from this slide area at the toe of the dam. The remainder of the embankment, aside from the crest, is covered with brush and trees up to two feet in diameter. The upstream face contained an erosion berm along most of its length about one or two feet above pool elevation at the time of inspection. A pile of brush is located on the embankment crest immediately to the right of the principal spillway. The left abutment of the dam, adjacent to the principal spillway, is about three and one-half feet lower than the crest of the embankment. It appears that an old mill may have been located there at one time. Evidence in the form of erosion gullies indicates that this area has in the past conveyed flow from the reservoir (Photo 2). The left abutment adjacent to this area is

NAME OF DAM: HORNERS DAM

moderately steep and highly eroded. A channel on the right abutment appears to have been designed as the emergency spillway; however, the left abutment is currently one foot lower than the crest of the emergency spillway.

The embankment was constructed with a curvature in the downstream direction. A path follows the grass covered crest; however, the area of erosion and sliding adjacent to the principal spillway has affected the crest. This area is bare, unprotected, and slightly eroded.

An apparent area of seepage, near the mid-section of the dam and about twenty feet from the toe, was observed. This area was frozen and did not appear to be flowing at the time of inspection. This possible seep is channeled downstream beneath VA Route 625 through a 4-foot diameter corrugated metal pipe (C.M.P.) to the main downstream channel. No other seepage was noted.

### 3.1.3

Appurtenant Structures: The principal spillway, a rectangular-shaped, broad-crested concrete weir with concrete training walls, is 19.4 feet long (perpendicular to the flow), 11.6 feet wide, and 6.9 feet high. Slight cracks were observed at the base of the right training wall, and both walls are spalling at the water line. There are deteriorated wooden sills located at the entrance to the spillway where wooden gates formerly could be seated. Minor undercutting has occurred below the 18-inch thick concrete slab of the principal spillway at the outfall. The downstream side of the concrete weir is obstructed by one concrete post (8"x8") which supports a wooden cross beam for a foot-bridge across the spillway. This support is spalling, and a large crack has exposed rebar on the upper portion of the support.

The approach channel to the principal spillway is somewhat silted with leaves and sediment. The entrance to the spillway is divided into five sections by four 8-inch wide concrete piers. These piers contain slots where wooden gates at one time could be used to control the level of the reservoir. Only

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three of the five gates remain, and they are in a badly deteriorated condition. The four piers and training walls support an 8-inch square concrete beam that runs across the top of the spillway 6.9 feet above the spillway crest. Two horizontal telephone poles rest on the concrete training walls and support a 6-foot wide wooden bridge. This footbridge is comprised of loose 2"x4" wooden planks placed across the telephone poles.

There is a short drop of about 1.5 feet at the end of the outlet of the principal spillway. The immediate discharge channel is about 25 feet wide, and is underlain by very hard clay. The channel turns to the right and discharges into a pool about 100 feet downstream of the spillway. At the time of inspection, there was an hydraulic jump where the discharge channel emptied into the pool. The left bank of the discharge channel is steeply eroded, and the sliding of trees which overhang this bank could obstruct the channel in the future.

As stated above, it appears that the emergency spillway was constructed on the right abutment; however, the left abutment is about one foot lower than the right abutment, due to the removal of a mill on this abutment. This low area of the left abutment acts as a secondary spillway and provides a channel around the left training wall of the principal spillway and into the discharge channel. Brush and small trees are growing on the upper banks of the grass covered emergency spillway. The emergency spillway discharges into a small ditch running parallel to VA Route 625 toward the middle of the downstream channel. After joining another small ditch running from the apparent seep near the center of the dam, the channel crosses VA Route 625 through a 4-foot diameter conduit.

### 3.1.4

Reservoir Area: The reservoir banks are moderately steep and covered with trees and vegetation. There are no major signs of instability.

NAME OF DAM: HORNERS DAM

The extent of sedimentation in the reservoir was not directly observed; however, it is not expected to be significant. The depth of the reservoir was determined to be seven feet at a distance of 30 feet from the shore.

### 3.1.5

Downstream Channel: The downstream channel below VA Route 625 is wide and swampy. It is bound by moderately sloping banks on either side and the gradient of the channel is low. Trees and brush line the downstream channel to VA Route 625, which crosses the channel about 300 feet from the principal spillway. The major discharge channel meanders from the principal spillway down through a box culvert (4'x21') underneath VA Route 625. A secondary channel, formed from an apparent seep near the mid-section of the dam, flows beneath VA Route 625 through a 4-foot diameter C.M.P. The channel below VA Route 625 is heavily vegetated and inaccessible, due to swampy conditions.

### 3.1.6

Instrumentation: There is no instrumentation present on the dam.

## 3.2 Evaluation

In general, the dam and appurtenant structures are in fair condition. The slide area along the left embankment adjacent to the principal spillway should be repaired, compacted, and seeded. All trees along the upstream and downstream embankment should be removed by cutting them off at ground level. Trees with a trunk diameter greater than 3 inches should also have their root systems removed. The resultant holes should be backfilled, compacted and seeded. A good grass cover should be established over the entire embankment. The brush pile adjacent to the principal spillway should be removed.

The low area on the left abutment where a mill was once located should be completely backfilled, compacted, and seeded to the average elevation of the crest of the dam. However, prior to backfilling of this area, professional consultants with training in structural engineering and hydraulics and hydrology should perform a structural analysis of the principal spillway to determine its adequacy and structural stability.

NAME OF DAM: HORNERS DAM

Riprap should be placed on the upstream face of the dam to minimize erosion due to wave action. The area of apparent seepage near the mid-section of the dam should be visually examined during all periods of high reservoir levels to determine any turbidity and/or increase in the rate of seepage. A staff gage should be installed to monitor reservoir levels above normal pool.

NAME OF DAM: HORNERS DAM

#### SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: The operation of the dam is an automatic function controlled by the crest of the principal spillway at 1000.0 feet T.B.M.
- 4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. An inspection or maintenance schedule has not been instituted.
- 4.3 Maintenance of Operating Facilities: There are no operating facilities at the dam.
- 4.4 Warning System: At the present time, there is no warning system or emergency action plan in operation.
- 4.5 Evaluation: Maintenance of the dam in the past has been inadequate. Regular inspections of the dam and appurtenant structures should be made and documented. A thorough check list should be compiled for use by the owner's representative as a guide for the inspections. Maintenance items should be corrected annually. A warning system and emergency action plan should be developed and put into operation.

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## SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: No design data were available for use in preparing this report.
- 5.2 Hydrologic Information: No rainfall, stream gage or reservoir stage records are maintained for this dam.
- 5.3 Flood Experience: No records were available.
- 5.4 Flood Potential: The Probable Maximum Flood (PMF), 1/2 Probable Maximum Flood (1/2 PMF), and the 100-year flood were developed and routed through the reservoir by use of the HEC-1 DB computer program (Reference 9, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's T<sub>c</sub> and R coefficients for the local drainage areas were estimated from basin characteristics. The rainfall applied to the unit hydrograph was taken from publications by the U.S. Weather Bureau and the National Oceanic and Atmospheric Administration (References 16 and 17, Appendix IV). Rainfall losses for the PMF and 1/2 PMF were estimated at an initial loss of 1.0 inches and a constant loss rate of 0.05 inches per hour thereafter. Rainfall losses for the 100-year flood were estimated at an initial loss of 1.5 inches and a constant loss rate of 0.15 inches per hour thereafter.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are provided in Table 1.1, Paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Normal flows are maintained by the crest of the principal spillway, which is at elevation 1000.0 feet T.B.M. When water in the reservoir rises above an elevation of 1003.8 feet T.B.M., it flows past the dam through the emergency spillway. However, a low area to the left of the principal spillway presently acts as a secondary spillway. This area has an elevation of 1002.6 feet T.B.M. and water will overflow this area before the emergency spillway. The dam has an average crest elevation of 1005.8 feet T.B.M.

Outlet discharge capacity was computed by hand; reservoir area was estimated from the Champlain, Virginia 7.5 minute USGS quadrangle; and storage capacity was computed by the HEC-1 DB program. Outlet discharge capacity and storage capacity curves were computed to elevations

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above the crest of the dam. All flood routings were begun with the reservoir at normal pool. Flow through the principal spillways was included in the routings.

- 5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal <sup>1</sup>	Hydrographs		
		100-year flood	1/2 PMF	PMF <sup>2</sup>
Peak flow, c.f.s.				
Inflow	4.5	5567	14,932	29,865
Outflow	4.5	5146	14,596	29,308
Peak elev., ft. T.B.M.	1000.2	1007.8	1009.7	1012.0
Non-overflow section <sup>3</sup> (elev. 1005.8 ft. T.B.M.)				
Depth of flow, ft.	-	2.0	4.1	6.4
Average velocity, f.p.s.	-	6.6	9.4	11.7
Total duration of over- topping, hrs.	-	4.0	11.3	20.1
Tailwater elev., ft. T.B.M.	989.6	-	-	-

<sup>1</sup>Conditions at time of inspection.

<sup>2</sup>The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region.

<sup>3</sup>Velocity estimates were based on critical depth at control section.

- 5.7 Reservoir Emptying Potential: There are no facilities for draining the reservoir.

- 5.8 Evaluation: Horners Dam is a "small" size - "significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range between the 100-year flood and the 1/2 PMF. Due to the risk involved, the 100-year flood was chosen as the SDF. The SDF was routed through the reservoir and found to overtop the dam by a maximum depth of 2.0 feet with an average critical velocity of 6.6 feet per second (f.p.s.). Total duration of dam overtopping would be 4.0 hours. The spillway is capable of passing up to 32 percent of the SDF or 6 percent of the PMF without overtopping the crest of the dam.

NAME OF DAM: HORNERS DAM

Conclusions pertain to present-day conditions and the effect of future development on the hydrology has not been considered.

NAME OF DAM: HORNERS DAM

## SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: Other than observations made at the time of inspection, no information is available on foundation conditions. The dam is located in the Atlantic Coastal Plain geologic region and is underlain by the Tertiary-age Calvert formation. This unit typically consists of sandy clay and fine-grained sand. The geologic map also shows a surface mantling of Quaternary-age upland sand and gravel in the area. Exposed soils in the left abutment consisted of light-colored clayey fine sand and clayey silt which appeared to be of low plasticity. The discharge channel of the principal spillway was underlain by an exposure of stiff clayey soils.

Evidence of substantial seepage was observed at one point in the foundation soils below the downstream face at the midsection of the dam. However, this area was completely frozen at the time of the inspection and active seepage was not observed. Based on the visual inspection of the dam, it is believed that the dam has no internal drainage system. Information on the keying of the dam into the foundation was not available.

### 6.2 Embankment

6.2.1 Materials: No information is available on the nature of the embankment materials. During the visual inspection, the outer embankment materials were observed to consist of brown clayey silt with fine sand. An excavated site of an old mill in the left abutment may have been a source of borrow for the dam. The embankment materials observed were considered to be of low plasticity.

6.2.2 Stability: Design plans or the results of a previous stability analysis were not available for use in this analysis. The embankment is assumed to be a homogeneous type consisting of fine-grained silty soils of low plasticity (classified as ML soils according to the USCS system). The dam is 16.7 feet high with a crest width of 8 feet. The downstream slope was observed at 1.2H:1V at Station 1+22, located 60 feet to the right of the principal spillway in a fifty-foot wide area of erosion.

NAME OF DAM: HORNERS DAM

At Station 4+60, located about 120 feet from the right abutment, the downstream slope was observed to be 2.5H:1V. The slope at this location is representative of the embankment in general. The upstream slope at Station 4+60 was found to be 1.7H:1V. Based on inspection of the dam spillways and appurtenances, the dam does not appear to have facilities for draining the reservoir in the event of an emergency, and is thus not considered susceptible to sudden drawdown.

According to guidelines outlined in Design of Small Dams by the Department of the Interior, Bureau of Reclamation, the upstream slope of a small homogeneous dam comprised of ML type soils, with a stable foundation, should be 3.0H:1V if not subject to rapid drawdown. The recommended downstream slope is 2.5H:1V. A crest width of 13.3 feet is recommended, considering the height of the dam. Based on these guidelines, the upstream slope and the crest width are inadequate. The downstream slope is generally adequate, but is inadequate in the fifty-foot wide area of sloughing and erosion adjacent to the principal spillway.

Tension cracks and/or movement of the downstream toe were not observed during the visual inspection. However, substantial sloughing and erosion of the downstream face were found along the fifty-foot section of embankment adjacent to the principal spillway. This sloughing has contributed to the steepened slope of the embankment observed at Station 1+22. An apparent slump block about 10 feet wide and 3 to 4 feet thick was also observed in this area. This possible slump appears to have moved downslope about 15 feet, carrying a live tree and attached root system. There was no evidence of seepage in this area or any other place on the downstream face. As mentioned earlier, an apparent seep was observed below the toe of the mid-section of the dam. Most of the remainder of the downstream face was covered with trees and brush and was relatively free of erosion and sloughing. The upstream face, however, contained an erosion berm along most of its

NAME OF DAM: HORNERS DAM

length about one to two feet above pool elevation at the time of inspection.

- 6.2.3 Seismic Stability: The dam is located in Seismic Zone 1, which presents no hazard from earthquakes, according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chief of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.
- 6.3 Evaluation: The results of a previous stability analysis were not available for review. The upstream slope and a portion of the downstream slope are steeper than recommended in the Bureau of Reclamation guidelines, and the crest is less than the recommended width. The area of slumping and erosion on the downstream face near the principal spillway requires remedial action to flatten the slope to a grade consistent with the remainder of the embankment for prevention of further slumping. In the event that the unoccupied house in the downstream channel should ever be reoccupied, or if any other residence is established along VA Route 625 within the downstream channel of Horners Dam, a qualified professional consultant should be retained to perform a stability check on the dam.

The apparent seep observed near the toe of the embankment should be visually examined during all periods of high reservoir levels to determine any turbidity and/or increase in the rate of seepage.

As described in Section 5 of this report, the dam would be overtopped by the SDF. The maximum depth of flow over the crest would be 2.0 feet with an average critical velocity of 6.6 feet per second (f.p.s.). Total duration of dam overtopping would be 4.0 hours. Because the critical velocity would exceed the effective eroding velocity for a vegetated earth embankment of 6.0 f.p.s., and the duration and depth of overtopping would be significant, the potential overtopping flows are considered to be detrimental to the stability of the embankment.

NAME OF DAM: HORNERS DAM

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: No construction plans, design specifications, as-built plans or any other engineering data for the dam were available for use in preparing this report. The dam and appurtenant structures were generally in fair overall condition at the time of the inspection. Deficiencies discovered during the field inspection and office analyses will require further investigation and remedial treatment. Maintenance of the dam is considered inadequate.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the SDF for the "small" size - "significant" hazard classification of Horner's Dam. The spillway is capable of passing up to 6 percent of the PMF or 32 percent of the SDF without overtopping the non-overflow section of the dam. Based on the present unoccupied status of the house located within the downstream channel about 200 feet downstream of the spillway a, dam failure from overtopping would not significantly increase the hazard to loss of life downstream from the dam over that which would exist just before overtopping failure. However, overtopping flows are considered detrimental to the embankment. Therefore, the spillway is adjudged as inadequate, but not seriously inadequate.

There is no warning system or emergency action plan currently in operation.

7.2 Recommended Remedial Measures: A formal warning system and emergency action plan should be developed and put into effect as soon as possible.

The seep near the center of the dam should be examined at regular intervals and after periods of heavy rain for turbidity and/or increase in flow which may indicate the potential for piping of embankment material.

In the event that the unoccupied house located within the downstream channel should ever be reoccupied, or if any other residence is established along VA Route 625 within the downstream channel of Horner's Dam, a qualified professional consultant should be retained to determine spillway adequacy, remedial work, and to assess the dam's stability. Included within the stability assessment should be an investigation to determine if the apparent seeps below the center of the downstream slope and the

NAME OF DAM: HORNERS DAM

slide area on the downstream slope pose a threat to the stability of the dam. The owner is required to engage the services of the consultant within two months of the reoccupancy of the existing house or establishment of new residence. The owner is required to have the consultant's report and to have reached an agreement with the Commonwealth of Virginia regarding remedial measures within six months of the reoccupancy or establishment of new residence.

Regular inspections of the dam and appurtenant structures should be made and documented. A thorough check list should be compiled for use by the owner or the owner's representative as a guide for the inspections. Maintenance items should be completed annually.

The following repair items should be accomplished as part of the general maintenance of the dam:

- 1) Cut all trees on the embankment at ground level. All trees with a trunk diameter greater than 3 inches should also have their root systems removed. The resultant holes should be backfilled, compacted and seeded.
- 2) Backfill, regrade, compact and seed all areas of erosion.
- 3) Install a staff gage to monitor reservoir levels above normal pool.
- 4) Backfill, compact and seed the low area on the left abutment to the average elevation of the embankment crest.
- 5) Remove the pile of brush located on the downstream side of the crest of the embankment immediately to the right of the principal spillway.
- 6) Place riprap on the upstream face of the dam to minimize erosion due to wave action.

NAME OF DAM: HORNERS DAM

**APPENDIX I**  
**PLATES**

**CONTENTS**

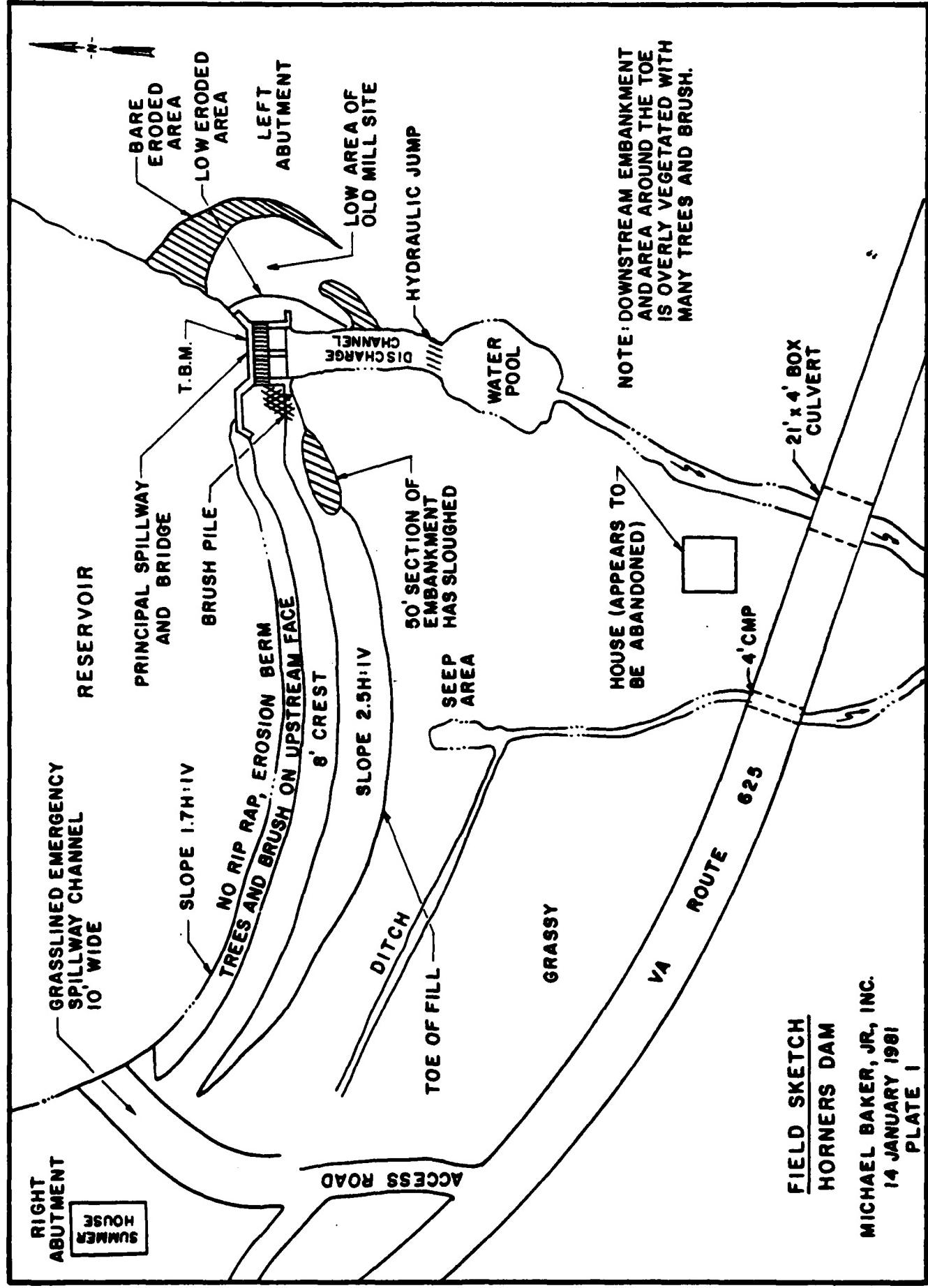
**Location Plan**

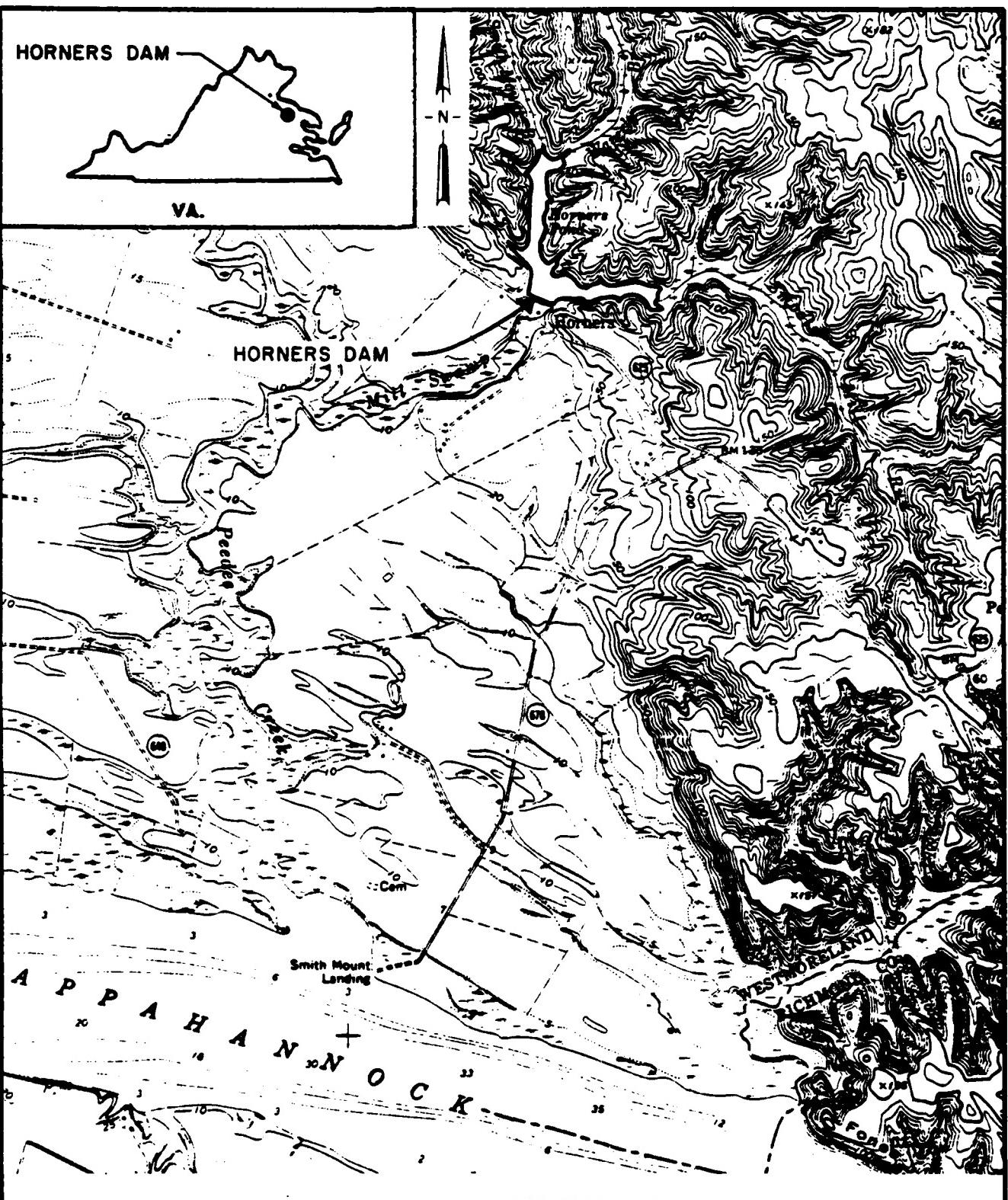
**Plate 1: Field Sketch**

**Plate 2: Top of Dam Profile**

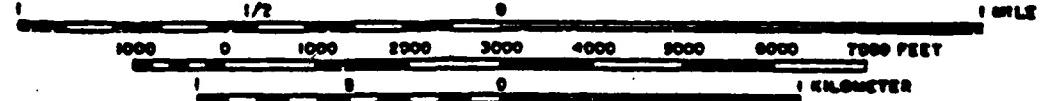
**Plate 3: Typical Cross Sections**

**NAME OF DAM: HORNERS DAM**





SCALE 1:26700



**LOCATION PLAN**  
**HORNERS DAM**

#### **REFERENCES:**

- REFERENCES:**  
I. U.S.G.S. 7.5' CHAMPLAIN, VA.  
QUADRANGLE. PHOTOREVISED 1973

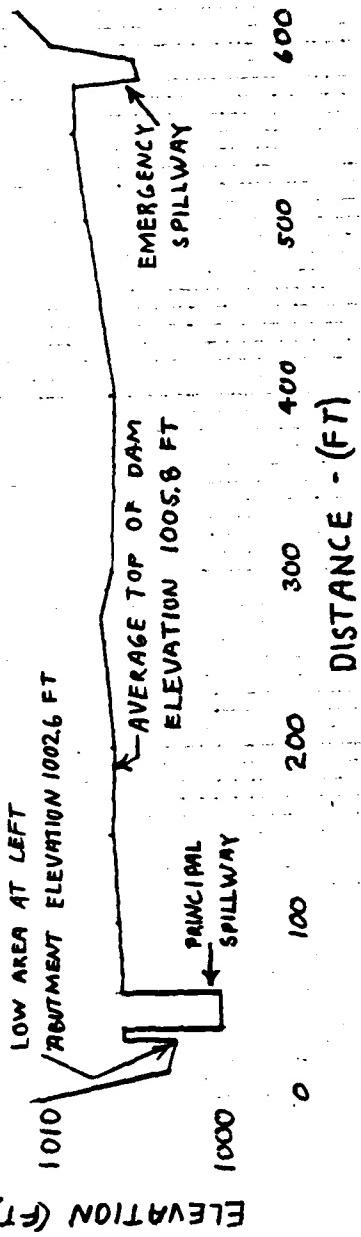
MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

TOP OF DAM PROFILE LOOKING DOWNSTREAM

Subject VIRGINIA DAMS S.O. No. \_\_\_\_\_  
Horners Dam Sheet No. \_\_\_\_\_ of \_\_\_\_\_  
Top of Dam Profile Drawing No. \_\_\_\_\_  
Computed by APK Checked by \_\_\_\_\_ Date \_\_\_\_\_



ELEVATION (FT)

PLATE

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject VIRGINIA DAMS

S.O. No. \_\_\_\_\_

HORNERS Dam

Sheet No. \_\_\_\_\_ of \_\_\_\_\_

CROSS SECTIONS

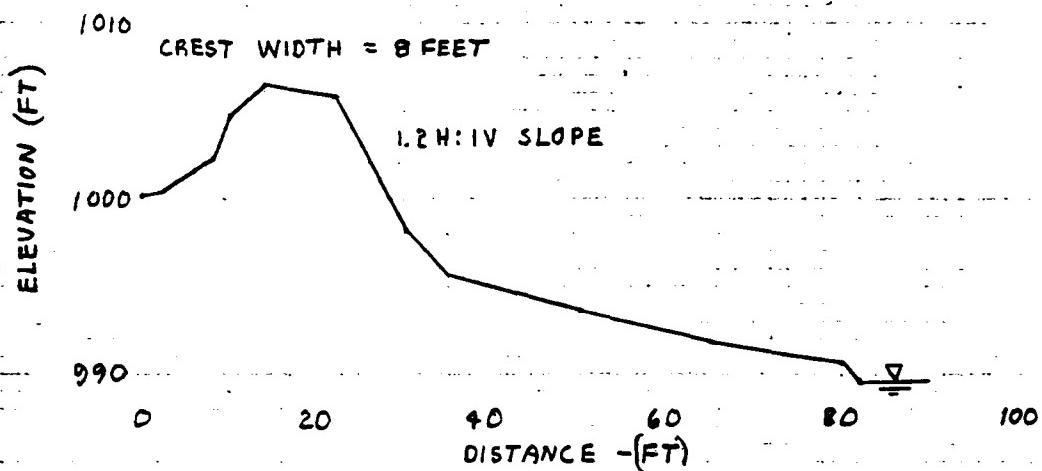
Drawing No. \_\_\_\_\_

Computed by APK

Checked by \_\_\_\_\_

Date \_\_\_\_\_

DAM CROSS SECTION AT STA. 1+22



DAM CROSS SECTION AT STA. 4+60

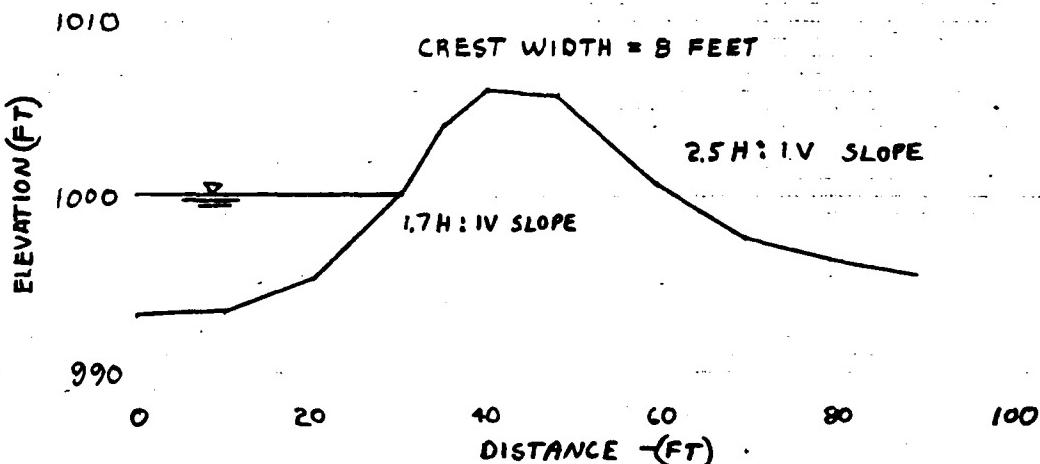


PLATE 3

**APPENDIX II**  
**PHOTOGRAPHS**

CONTENTS

- Photo 1: Principal Spillway from Top of Left Abutment
- Photo 2: Abandoned Mill Area and Erosion on Left Abutment
- Photo 3: Left Side of Downstream Embankment - Slide Area Located on Left Center of Photo
- Photo 4: Seepage Channel Near Center of Dam (Looking Toward Embankment)
- Photo 5: Trees and Brush on Upstream Embankment
- Photo 6: Emergency Spillway on Right Abutment

Note: Photographs were taken on 13 January 1981.

NAME OF DAM: HORNERS DAM

**HORNERS DAM**



**PHOTO 1. Principal Spillway from Top of Left Abutment**



**PHOTO 2. Abandoned Mill Area and Erosion on Left Abutment**

**HORNERS DAM**



**PHOTO 3. Left Side of Downstream Embankment - Slide Area Located  
on Left Center of Photo**



**PHOTO 4. Seepage Channel near Center of Dam  
(Looking Toward Embankment)**

**HORNERS DAM**



**PHOTO 5. Trees and Brush on Upstream Embankment**



**PHOTO 6. Emergency Spillway on Right Abutment**

**APPENDIX III**  
**VISUAL INSPECTION CHECK LIST**

Check List  
Visual Inspection  
Phase 1

Name of Dam Horners Dam County Westmoreland State Virginia Coordinates Lat. 3806.8  
Long. 7656.9

Date of Inspection 13 January 1981 Weather Partly cloudy Temperature 20° F.

Pool Elevation at Time of Inspection 1000.2 ft. T.B.M.\* Tailwater at Time of Inspection 989.6 ft. T.B.M.\*

\*All elevations are referenced to a Temporary Bench Mark (T.B.M.) located at the bottom of the left training wall on the crest of the principal spillway. The assumed elevation was 1000.0 ft.

Inspection Personnel:

Michael Baker, Jr., Inc.:

Anthony P. Klimek  
Stephen H. Shoemaker  
David M. Meredith

Virginia State Water Control Board:

Ed Constantine

Owner's Representatives:

None

Stephen Shoemaker Recorder

Name of Dam HORNER'S DAM

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	There is a slide area adjacent to the principal spillway. This slide area has an approximate slope of 1.2H:1V and involves about 50 ft. of embankment. Brush, trees and systems appear to have settled within the soil from this slide area at the toe of the dam. There are no other signs of movement at the toe.	This slide area of the embankment should be regraded to a more stable slope, compacted and seeded. Remedial work should be determined by a qualified professional consultant after a more detailed examination.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Sloughing has occurred at the left end of the embankment as described above. The remainder of the embankment is covered with brush and trees up to 2 ft. in diameter. Trees have affected the grading of both the upstream and downstream slopes. The upstream face contained an erosion berm along most of its length 1 or 2 ft. above pool elevation at the time of inspection. The left abutment, adjacent to the principal spillway is about 3.5 ft. lower than the crest of the embankment. It appears that an old mill may have been located there at one time. Evidence in the form of erosion gullies indicates that this area has conveyed flow from the reservoir, around the left training	Riprap should be placed on the upstream embankment to minimize erosion.

Name of Dam HORNERS DAM

EMBANKMENT

VISUAL EXAMINATION OF

SLOUGHING OR EROSION OF  
EMBANKMENT AND ABUTMENT  
SLOPES (continued)

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOUGHING OR EROSION OF  
EMBANKMENT AND ABUTMENT  
SLOPES (continued)

wall to the discharge channel of the principal spillway. The left abutment is moderately steep and highly eroded.

VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST

The dam has a downstream curvature, and there are no signs of undue settlement. A path follows the grass-covered crest. However, the slide and erosion area adjacent to the principal spillway as described above has affected the crest. This area is bare, unprotected and slightly eroded.

RIPRAP FAILURES

There is no riprap on the dam.

Riprap should be placed on the upstream face of the dam to minimize erosion due to wave action.

VEGETATION

Both upstream and downstream faces of dam are covered with brush, brambles and trees. Some trees on the downstream face are in excess of 2 ft. in diameter. A pile of brush is located on the downstream crest of the embankment immediately to the right of the principal spillway.

All trees should be removed by cutting them off at ground level. All trees with a trunk diameter of greater than 3 in. should have their root systems removed. The resultant holes should be backfilled, compacted and seeded. The brush pile should be removed. A good grass cover should be established over the entire embankment.

Name of Dam HORNERS DAM

EMBANKMENT

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

JUNCTION OF EMBANKMENT  
AND ABUTMENT, SPILLWAY  
AND DAM

The principal spillway is located at the left abutment. As previously described, this area apparently contained a mill at one time. The mill is now absent, leaving a depression which is the lowest point of the dam. This area is currently about 1 ft. lower than the crest of the emergency spillway. The left abutment area is comprised of a highly eroded, 40 ft. high bank above the void of the old mill. The right abutment contains what appears to be the designed emergency spillway. There was no erosion observed on or adjacent to the right abutment.

ANY NOTICEABLE SEEPAGE

An apparent area of seepage near the mid-section of the dam and about 20 ft. from the toe was observed. It was frozen, and did not appear to be flowing at the time of inspection. This seep is channeled downstream beneath VA Route 625 through a 4-ft. diameter corrugated metal culvert to the main downstream channel. No other signs of seepage were observed.

The low area on the left abutment should be completely backfilled, compacted and seeded.

A staff gage should be installed to monitor reservoir levels above normal pool.

STAFF GAGE AND RECORDER

None observed

DRAINS

None observed

**Name of Dam:** HORNERS DAM

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	<p>The principal spillway is a rectangular shaped broad-crested concrete weir. It is 19.4 ft. long, 11.6 ft. wide and 6.9 ft. high. The spillway is bound by 5.8 ft. high, 8 in. thick concrete training walls. Slight cracks were observed at the base of the right training wall. There is minor spalling of both training walls near the water line.</p>	<p>Prior to backfilling the area adjacent to the principle spillway, a professional consultant should perform a structural analysis of the left training wall to determine its adequacy and structural stability.</p>
APPROACH CHANNEL	<p>The approach channel is somewhat silted with leaves and sediment. The entrance to the spillway is divided into five sections by four 8 in. wide concrete piers. These piers contain slots where wooden gates at one time could be used to control the level of the reservoir. Only three of the five gates remain and they are in a badly deteriorated condition.</p>	

## PRINCIPAL SPILLWAY

Name of Dam: HORNERS DAM

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<b>DISCHARGE CHANNEL</b>	<p>There is a short drop at the downstream end of the weir of about 18 in. The discharge channel is about 25 ft. wide and is comprised of a very hard clay. The channel turns to the right and discharges into a pool about 100 ft. downstream of the spillway. At the time of inspection, there was an hydraulic jump where the discharge channel discharges into the pool. The left bank is eroded and the sliding of trees which overhang this bank could obstruct the channel in the future.</p>	
<b>BRIDGE AND PIERS</b>	<p>A 6 ft. wide wooden footbridge crosses the spillway. Two horizontal telephone poles rest on the concrete training walls and a cross beam which is supported by the 8 in. concrete post and one of the piers. The bridge is composed of 6 ft. long, 2 in. by 4 in. wooden planks that lay on top of the telephone poles and are not nailed down. The four piers and training walls support an 8 in. square concrete beam that runs across the width of the spillway at the entrance, 6.9 ft. above the spillway crest.</p>	
<b>EMBANKMENT MATERIALS</b>	<p>The outer embankment materials consist of brown clayey fine sand considered to be of low plasticity. The ground surface at the time of inspection was generally dry.</p>	

Name of Dam: HORNERS DAM

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not Applicable	
APPROACH CHANNEL	The emergency spillway is located on the right abutment. The crest elevation of this spillway is currently about a foot higher than the void area on the left abutment. The approach channel is a well vegetated grass-lined trapezoidal channel about 10 ft. wide at the bottom.	
DISCHARGE CHANNEL	The emergency spillway is grass covered with small trees and brush growing on its upper banks. It discharges into a flat area downstream from the dam and flow is directed to a small ditch that runs parallel to VA Route 625 and the embankment toward the middle of the dam. This ditch drains into the channel from the apparent seep near the center of the dam and crosses under VA Route 625 through a 4-ft. diameter culvert.	
BRIDGE AND PIERS	None observed	
GATES AND OPERATION EQUIPMENT	None observed	

INSTRUMENTATION			
Name of Dam:	OBSERVATIONS	REMARKS OR RECOMMENDATIONS	
HORNERS DAM			
VISUAL EXAMINATION			
MONUMENTATION/SURVEYS	None observed		
OBSERVATION WELLS	None observed		
WEIRS	None observed		
PIEZOMETERS	None observed		
OTHER			

RESERVOIR		REMARKS OR RECOMMENDATIONS
Name of Dam:	HORNERS DAM	
<b>VISUAL EXAMINATION OF</b>	<b>OBSERVATIONS</b>	

**SLOPES**      The reservoir banks are moderately steep and covered with trees and vegetation. There are no major signs of instability.

**SEDIMENTATION**      Sedimentation was apparent in the approach to the spillway. The extent of sedimentation in the reservoir was not directly observed; however, it is not expected to be significant. The depth of the reservoir was determined to be 7.0 ft. at 30 ft. from the shore.

Name of Dam: HORNERS DAM

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Trees and brush line the downstream channel to VA Route 625 which crosses the channel about 300 ft. from the spillway. The major discharge channel meanders from the spillway down through a box culvert (4 ft. x 21 ft.) underneath VA Route 625. A secondary channel formed from an apparent seep near the mid-section of the dam flows underneath VA Route 625 through a 4 ft. diameter pipe culvert. Below VA Route 625, the channel is heavily vegetated and inaccessible due to swampy conditions.	
SLOPES	The downstream channel below VA Route 625 is wide and swampy. It is bound by moderately sloping banks on either side and the gradient of the channel is low.	
APPROXIMATE NO. OF HOMES AND POPULATION	There is one unoccupied house located in the channel about 200 ft. downstream of the spillway. This house appears to be abandoned but could potentially be renovated. A house on the bank above the emergency spillway on the right abutment was unoccupied during the time of inspection. This house would be unaffected should the dam fail. An occupied house located about 350 ft. southeast of the spillway is located above the elevation of the dam; it would also be unaffected should the dam fail.	

**APPENDIX IV**  
**GENERAL REFERENCES**

## GENERAL REFERENCES

1. Bureau of Reclamation, U.S. Department of the Interior, Design of Small Dams, A Water Resources Technical Publication, Revised Reprint, 1977.
2. Chow, Ven Te, Handbook of Applied Hydrology, McGraw - Hill Book Company, New York, 1964.
3. Chow, Ven Te, Open Channel Hydraulics, McGraw - Hill Book Company, New York, First Edition, 1959.
4. Commonwealth of Virginia, "Geologic Map of Virginia," Department of Conservation and Economic Development, and Division of Mineral Resources, 1963.
5. HR 33, "Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations of 6 to 48 Hours," (1956).
6. King, Horace Williams and Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, McGraw - Hill Book Company, New York, 1963.
7. Soil Conservation Service, "National Engineering Handbook - Section 4, Hydrology," U.S. Department of Agriculture, 1964.
8. Soil Conservation Service, "National Engineering Handbook - Section 5, Hydraulics," U.S. Department of Agriculture.
9. U.S. Army, Hydrologic Engineering Center, "Flood Hydrograph Package (HEC-1), Dam Safety Investigations, Users Manual," Corps of Engineers, Davis, California, September 1978.
10. U.S. Army, Hydrologic Engineering Center, "HEC-2 Water Surface Profiles, Users Manual," Corps of Engineers, Davis, California, October 1973.
11. U.S. Army, "Inventory of United States Dams," Corps of Engineers, 9 September 1978.
12. U.S. Army, Office of the Chief of Engineers, "Appendix D, Recommended Guidelines for Safety Inspection of Dams," National Program of Inspection of Dams, Volume 1, Corps of Engineers, Washington, D.C., May 1975.

NAME OF DAM: HORNERS DAM

13. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-163 (Draft Engineering Manual), "Spillway and Freeboard Requirements for Dams, Appendix C, Hydrometeorological Criteria and Hyetograph Estimates," (August 1975).
14. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-188, "Engineering and Design, National Program of Inspection of Non-Federal Dams," Corps of Engineers, Washington, D.C., 30 December 1977.
15. U.S. Army, Office of the Chief of Engineers, Engineer Technical Letter No. ETL 1110-2-234, "Engineering and Design, National Program of Inspection of Non-Federal Dams, Review of Spillway Adequacy," Corps of Engineers, Washington, D.C., 10 May 1978.
16. U.S. Department of Commerce, "Technical Paper No. 40, Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years," Weather Bureau, Washington, D.C., May 1961.
17. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, "Hydrometeorological Report No. 51, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Washington, D.C., June 1978.

NAME OF DAM: HORNERS DAM